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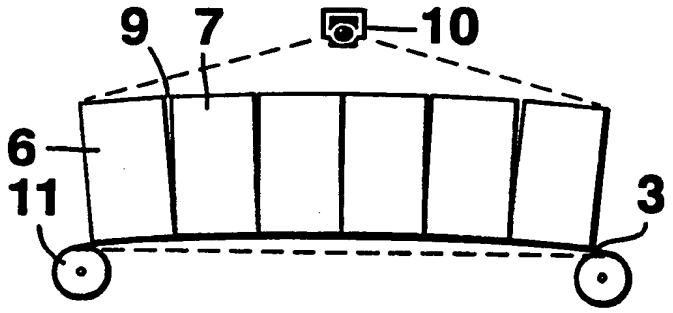
(54) Title: METHOD AND APPARATUS FOR AUTOMATIC CONTROL OF A SEPARATION OF A SET OF ROLLS LEAVING A SLITTER

(57) Abstract

Method of and arrangement for checking the separation of paper or board rolls and pub rolls on a slitter–winder. In the method the rolls are removed as an unbroken set (8), i.e. a set, from support rolls (16) of the slitter–winder and the unbroken roll set is transferred to the checking point of the set, where the separation of the set is checked. The check happens in such way that a position difference (9) is set between adjacent rolls (6, 7) in such way that the edges of the rolls (6, 7) move with respect to each other, unless they are attached to each other, after which the spaces between the rolls (6, 7) that have gotten a position difference (9) are indicated by a reading device, and the number of indicated position differences (9) is compared to a defaut value, which is lower by one than the number of rolls in the roll set (8).



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Method and apparatus for automatic control of a separation of a set of rolls leaving a slitter

The present invention concerns a method as defined in the preamble of claim 1 of checking the separation of a set of multiple successive rolls, in short a set, coming from a slitter-winder used in slitting-winding paper rolls, board rolls and pulp rolls.

Further, the invention concerns an arrangement for applying the method.

A slitter-winder is used for slitting-winding narrower rolls according to customers' orders from a wide jumbo roll made by a paper machine or a board machine. Modern slitter-winders are very highly automatized and the actual slitting-winding and making of the rolls don't require manual actions. However, the roll handling, which takes place in front of the slitter-winder, still includes many manual stages, which mainly consist of checking rolls or a roll set. These stages prevent the decrease of the manning at the slitter-winder, and further, these stages are monotonic and, if carried out against regulations and carelessly, even dangerous. There are two main types of slitter-winders: centre reeler slitter-winder, in which the slit rolls are delivered from the slitter-winder in two sets to the different sides of the slitter-winder, and support roll slitter-winder, in which the rolls are delivered as an unbroken set. The rolls made on a support roll slitter-winder have to be separated from each other for a quality-check before they can be moved further to a marking station and wrapping. Therefore, one manual stage required at the support roll slitter-winder is checking that the rolls made as a set are separated. The separation of rolls in a set can take place at various stages of moving the set, but the check is usually carried out in such way, that the set is curved i.e. the rolls in the middle are lifted, whereupon the ends of the rolls are separated from each other and a space is created between them. An operator checks ocularly that all the rolls are separated from each other and, if needed, wedges the attached rolls apart. In a similar way as the support roll slitter-winder, operate also slitter-winders rolling on belts, so here a support roll slitter-winder means slitter-winders that deliver a set of rolls as one set.

Checking a set takes place in different stages in different equipment layouts. If a curver is placed under a conveyor at the lower end of a ramp next to the slitter-winder, the checking of the set takes place as follows. The set rolls from the slitter-winder tipping device down the ramp to the set stopper, which stops the whole set on the conveyor at the lower end of the ramp. Under the conveyor there is a curver, which bends the conveyor and the rolls in the set into a curve. The operator checks that there is a space between all the rolls and, if needed, separates the rolls. The conveyor then takes the rolls away from the front area of the slitter-winder to the next conveyor, the rolls are disconnected from each other and are transferred for wrapping, further processing or, if needed, rewinding. The advantage of this layout-alternative is that the operator doesn't have to go to the front of the slitter-winder or to the ramp at all, but instead he can handle rolls that are at the side of the slitter-winder field, which is safer.

The checking of the set can also take place at a stop gage line on the ramp. Thus the set coming from the tipping device of the slitter-winder rolls on the ramp to the stop gage line consisting of sectors, where the entire set is stopped. The stop gage line is curved, whereupon the rolls in the set bend into a curve. The operator checks the separation, after which a part of the set, e.g. a half of it, can be released down onto the conveyor. Next, the operator attaches marking stickers on the rolls and the first half of the set is taken away, after which the second half of the set is released down onto the conveyor and taken away.

The disadvantage of this solution is that the operator has to go to the ramp, whereupon he definitely has to take care of that the rolls have stopped at the stop gage line and that they are not starting to move yet and, correspondingly, that there is no new roll set coming from the slitter-winder yet. Also, enough time has to be reserved for the operator's work, so that he has time to carry out the checks on the set safely. Therefore, the operation of the slitter-winder and the conveyor system slows down.

Further, the checking of the set separation can alternatively be carried out as early as in the tipping device of the slitter-winder. Then the information on rolls that are

stuck is received as close to the slitter-winder as possible, which is advantageous to the operation of the quality system. In this case the primary side of the tipping device i.e. the base on which the slit rolls are moved is crowned. The delivery side of the tipping device is typically straight. The checking of the rolls is carried out while the rolls are on the crowned part of the tipping device. In this embodiment the operator has to go to the front of the slitter-winder, so it's necessary that at least the tipping device of the slitter-winder is locked for the duration of the check. Therefore this way of operation also slows down the operation of the slitter-winder.

The object of the present invention is to provide a method by which the checking of the set separation can be done without manual stages, whereupon the slitter-winder operator can follow the operation of the system safely in the control room.

The basis of the invention is that differences in position, e.g. spaces, are created between the ends of the rolls in the set, and the number of these spaces is indicated by a reading device and it is compared to the number of rolls reported by the slitter-winder, whereupon the number of spaces indicated in a succesful separation is lower by one than the number of the rolls in the set reported by the slitter-winder. If fewer spaces are indicated, it is known that there are rolls in the set that are attached to each other.

More precisely, the method in accordance with the invention is characterized in what is stated in the characterizing part of claim 1.

On the other hand, the arrangement in accordance with the invention is characterized in what is stated in the characterizing part of claim 6.

By means of the invention, significant advantages are achieved.

By means of the invention, the set separation can be checked fully automatically, so the operator doesn't have to go the movement range of the rolls at all. Even when there are stiff rolls in the set, the operator can separate them conventionally by wedging, after the rolls have leaved the slitter-winder field and are definitely

immobile on the conveyor. The checking of the separation can be carried out in any spot where the rolls move as an unbroken group. It is obviously most advantageous that the separation is checked as close to the slitter-winder as possible, i.e. for example in the tipping device of the slitter-winder. Then the information on a separation error is received as soon as possible, whereupon the error causes as few disruptions as possible in the operation of the system. Also, the tipping device doesn't have to be stopped for the duration of the check, but the checking can be carried out while the rolls move over the crowned area, whereupon the operation of the system speeds up. The invention can be applied in many existing devices, whereupon simple accessories are enough for realizing it, and the realization costs are low. The set check can be realized e.g. by a line camera, whereupon even a wide set up to 10 m can be checked by two cameras. This makes the operator's work easier and if there are no disturbances the operation of the winder can be controlled safely in the control room.

In the following, the invention will be described in more detail with reference to the figures in the accompanying drawing.

Figure 1 is an illustration of a slitter-winder's operating area to which the slit rolls are moved.

Figures 2 - 4 are schematic illustrations of the operation of the invention in connection with the arrangement illustrated in Fig. 1.

Figure 5 is an illustration of another type of a slitter-winder's operating area.

Figure 6 is an illustration of a third type of a slitter-winder's operating area.

Figure 7 and Figure 8 are cross sections of a tipping device of a slitter-winder.

In Fig. 1, there is a tipping device 1 of a slitter winder, below which there is a ramp 2 and at the end of the ramp there is a first conveyor 3 and a set stopper 4 placed next to the conveyor. The set stopper 4 consists of several stoppers that are

placed side by side, of which a certain number is chosen to operation position depending on what kind of a roll set is coming from the slitter-winder. At the end of the first conveyor 3 there is a next conveyor 5, which transfers the rolls further to a wrapping machine.

In the layout shown in Fig. 1 the transfer of the rolls happens as follows. A set coming from the tipping device 1 of the slitter-winder rolls downwards on the ramp 2 until it arrives on the conveyor 3, after which the rolls hit the stoppers of the set stopper 4. The set stopper 4 stops an entire roll set 8 on the conveyor 3. This situation is shown in Fig. 2. When the rolls have stopped on the conveyor 3, they have to be separated from each other. This happens by curving, i.e. by lifting the roll set upwards in a curved position. The curving is carried out in such way that the top surface of the conveyor 3 is lifted upwards in the area between rail wheels 11. Thus the upper edges of the rolls are separated from each other and a space 9 is created between the rolls. If for example the two outermost rolls 6 and 7 of the roll set 8 remain attached to each other, no space will be created between them. When the roll set, in short the set 8 has been curved, the separation of the rolls from each other can be detected by a line camera 10 placed above the roll set. It is advantageous to use a line camera with a PC-interface for the checking of the set. The image field of one line camera is sufficient for a set 4,5 m in width, and for a set over 4,5 m in width up to 10 m in width, two cameras are needed. Typically, the resolution of the line camera is 2048 pixels. With this resolution, a space between rolls can be detected if the difference between their upper edges is at least 1 cm.

When the number of spaces created by curving is detected, this number is compared to the default value calculated based on the number of rolls reported in the information of the slitter-winder set. Since the number of created spaces 9 is always lower by one than the number of rolls in a set, the default value is always the number of rolls minus one. If a lower number than this is detected in the check, the operator is given an alarm that there are rolls in the set that have remained attached to each other. Then the operator can for example separate the attached rolls from each other manually by wedging. If all the rolls have separated from each other, they can all be transferred forwards in the system to the second conveyor 5.

In the solution shown in Fig. 5 the separation of the set is checked by a sectored stop gage 12, which is arranged in the ramp 2 and which is curved. The operation in this layout-alternative happens in such way that the set rolls from the tipping device of the slitter-winder onto the ramp 2. The rolls are stopped at a stop gage line 12 consisting of sectors, which stops the entire set. The stop gage line 12 is curved, whereupon the separation can be checked as described in the example above. If, according to the check, all the rolls have separated from each other, half of the set can be released down. The rolls that have been released down are stopped by the set stopper 4 on the conveyor 3. This first half of the set is then transferred to a next conveyor 13, from which the rolls can be ejected by a sectored ejector 14 to the following handling stage. The curving that takes place at the sectored stop gage can take place in two ways. The position of the sectors in the sectored stop gage can be changed after the stopping, whereupon the rolls move with respect to each other. Alternatively, a separate curving member can be created in connection with the sectored stop gage.

In the solution shown in Figs. 6, 7 and 8 the checking of the set takes place on a tipping device 1 of the slitter-winder. The tipping device is shown in Figs. 7 and 8 in cross-section. The tipping device 1 of the slitter-winder is placed next to support rolls 16 of the slitter-winder. Rolls 6 rest on the support rolls. The tipping device 1 consists of a reception plane 17 and of a delivery plane 18, which is joined to it in the form of the letter v, and they are stiffly joined to each other and jointed to the shaft 19. The reception plane 17 is crowned, i.e. its centre is higher than the edge parts of the tipping device in the direction of the breadth of the tipping device 1 and the set.

When the set is transferred over the crowned plane, the rolls curve while on the plane area as shown in Figs. 3 and 4. In the ramp 2 there is a separation stopper 15 and in connection with the first conveyor 3 at the lower end of the ramp there is a conventional set stopper 4. From the first conveyor 3 the rolls can be transferred further to a conveyor 5. The separation of the set is checked in this case as soon as the set has been transferred to the tipping device 1 of the slitter-winder. The line cameras have thus been placed directly in connection with the slitter-winder.

This layout-alternative makes it possible to separate even stiff rolls automatically, whereupon no manual stages are required. The arrangement is also very flexible to use. If rolls that are attached to each other are detected on the tipping device of the slitter-winder, the roll set can still be tipped straight to the ramp 2 and the rolls can be separated by the separation stopper 15. This happens either by stopping a part of the rolls to the separation stopper 15, or by stopping the entire roll set to the separation stopper 15 and after that releasing a part of the rolls forwards. If there are no rolls that are attached to each other in the set, the entire set can be driven over the separation stopper straight to the set stopper 4 and to the conveyor 3. Thus the roll set can be moved forwards quickly. The separation stopper 15 can also be used as a intermediate storing place, when there is a new roll set coming from the tipping device of the slitter-winder before all the rolls have been removed from the first conveyor 3.

Instead of a crowned plane or curving the position difference between the rolls in the roll group required for indicating the separation can also be created in other ways. One alternative is to equip the set stopper 4 with an intermediate station. Thus, every other roll in a set that has been released down is pushed by the set stopper 4 a little, e.g. 5 cm backwards, whereupon a discontinuity is created between the edges of the rolls. Alternatively, a half of the rolls can remain in the intermediate position from the beginning. Thus, there is a small positioning difference between the rolls and the separation can be check e.g. by a line camera as described above. Instead of a set stopper 4 the separation stopper 15 can be equipped with corresponding devices. In the tipping device of the slitter-winder can also be placed separators or ejectors of corresponding type, with which a discontinuity can be created between the edges of the rolls.

In addition to what has been described above, this invention also has other embodiments. The layout-alternatives described above are only examples showing which operating environment the invention is related to. The means shown in the various layouts can be combined and used even in other solutions, and particularly the location of the conveyors connected to the slitter-winder can be chosen freely.

Instead of a line camera, another suitable reading device can naturally be used, and this reading device can be placed even in another position than straight above the set.

The set doesn't necessarily have to be stopped for checking the separation, if the speed and the capacity of the reading device and the data processing devices is sufficient. Then the separation of the set can be checked on the tipping device of the slitter-winder without stopping the roll set or on the ramp by creating a curved part in the ramp.

Claims

1. A method of checking the separation of paper or board rolls and pulp rolls on a support roll slitter-winder, in which method:

- removing the rolls as a unbroken set (8), i.e. a set, from support rolls (16) of the slitter-winder,

- transferring the unbroken roll set to and, if needed, stopped at the checking point of the set, and

- checking the separation of the set,

characterized in that

- setting a position difference (9) between adjacent rolls (6,7) at the checking point in such way that the edges of the rolls (6,7) move with respect to each other unless they are attached to each other,

- indicating the spaces between the rolls (6,7) that have gotten a position difference (9) by a reading device (10), and

- comparing the number of indicated position differences (9) to a default value, which is lower by one than the number of rolls in the roll set (8).

2. A method as claimed in claim 1, **characterized** in that an alarm is given if the number of position differences is lower than the default value.

3. A method as claimed in claim 1 or 2, **characterized** in that the position difference (9) is set between the adjacent rolls (6,7) by placing the rolls on a crowned plane.

4. A method as claimed in claim 1 or 2, **characterized** in that the position difference (9) between the adjacent rolls (6,7) is set by placing the rolls on a curver, advantageously on a conveyor (3) comprising a curver, located at the lower end of a ramp (2) next to the slitter-winder.

5. A method as claimed in claim 1 or 2, **characterized** in that the position difference (9) between the adjacent rolls (6,7) is set by setting the sectors of a separation stopper (12) or of a set stopper (4) in different positions in such way that a postition differece is created between the rolls that are against them.

6. An arrangement for checking the separation of paper or board rolls and pulp rolls on a support roll slitter-winder, which arrangement comprises:

means for receiving and, if needed, for stopping at a set checking point an unbroken set of rolls (8), i.e. a set, coming from the support rolls of the support roll slitter-winder,

means for checking the separation,

characterized in

means for setting a position difference (9) between adjacent rolls (6,7) at the checking point in such way that the edges of the rolls (6,7) move with respect to each other unless they are attached to each other,

a reading device (10) for indicating the spaces between the rolls (6,7) that have gotten a position difference (9), and

a comparison device for comparing the number of indicated position differences (9) to a default value, which is lower by one than the

number of the rolls in the roll set (8).

7. An arrangement as claimed in claim 6, **characterized** in that the means for setting the position difference (9) between the adjacent rolls (6,7) are a crowned plane (17).

8. An arrangement as claimed in claim 6, **characterized** in that the means for setting the position difference (9) between the adjacent rolls (6,7) are a curver, advantageously a conveyor (3) comprising a curver, located at the lower end of a ramp (2) next to the slitter-winder.

9. An arrangement as claimed in claim 6, **characterized** in that the means for setting the position difference (9) between the adjacent rolls (6,7) are means for setting the sectors of a separation stopper (12) or of a set stopper (4) in different positions in such way that a position difference is created between the rolls that are against them.

10. An arrangement as claimed in any of the claims 6 to 9, **characterized** in that the reading device is at least one line camera (10).

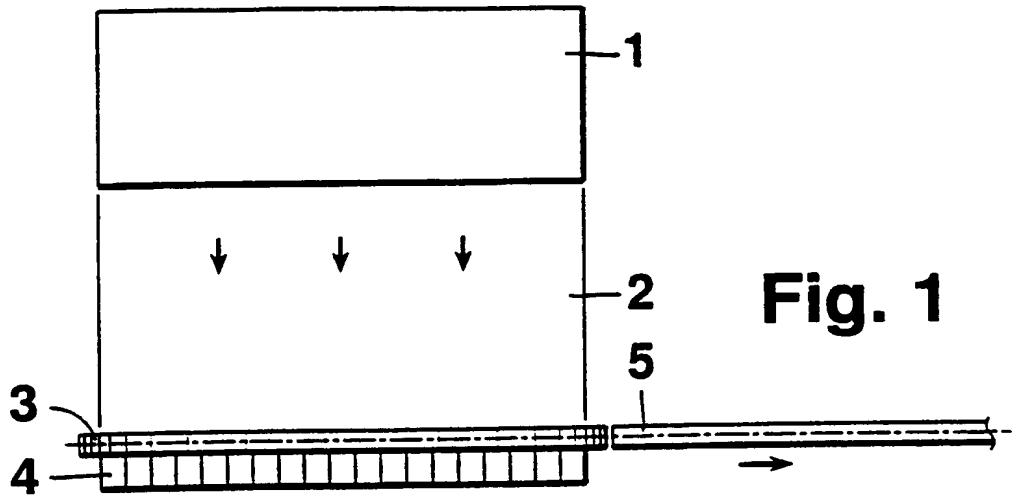

Fig. 1

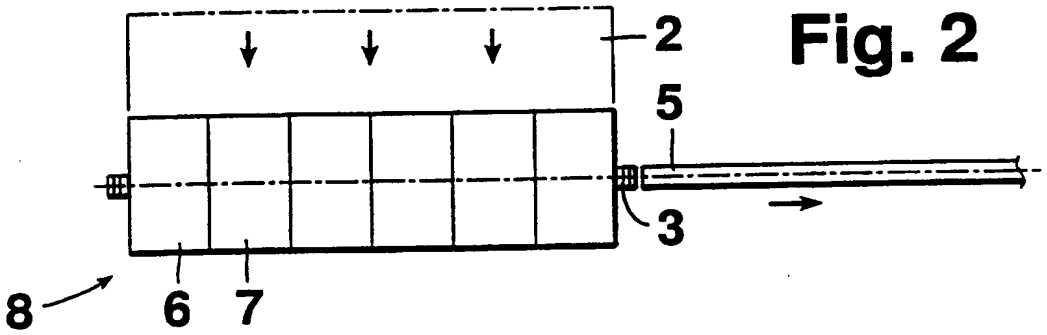

Fig. 2

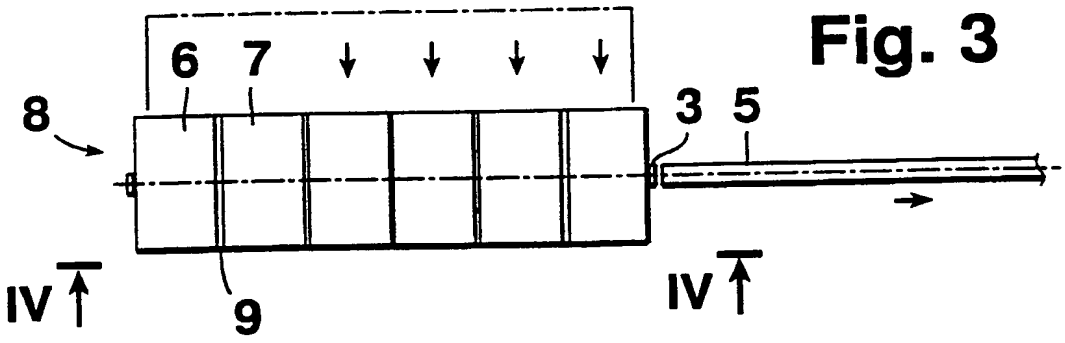

Fig. 3

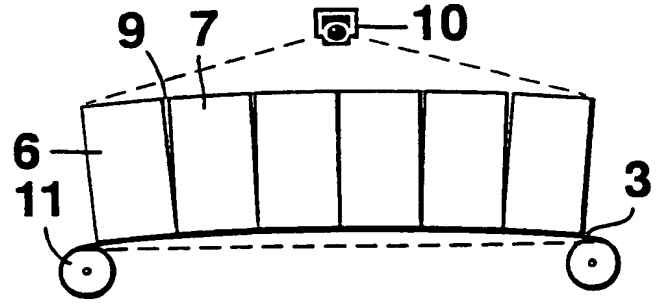

Fig. 4

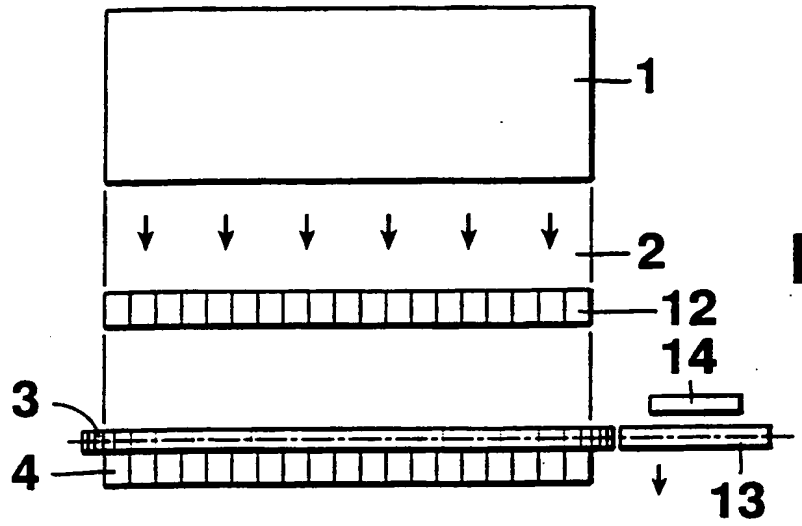

Fig. 5

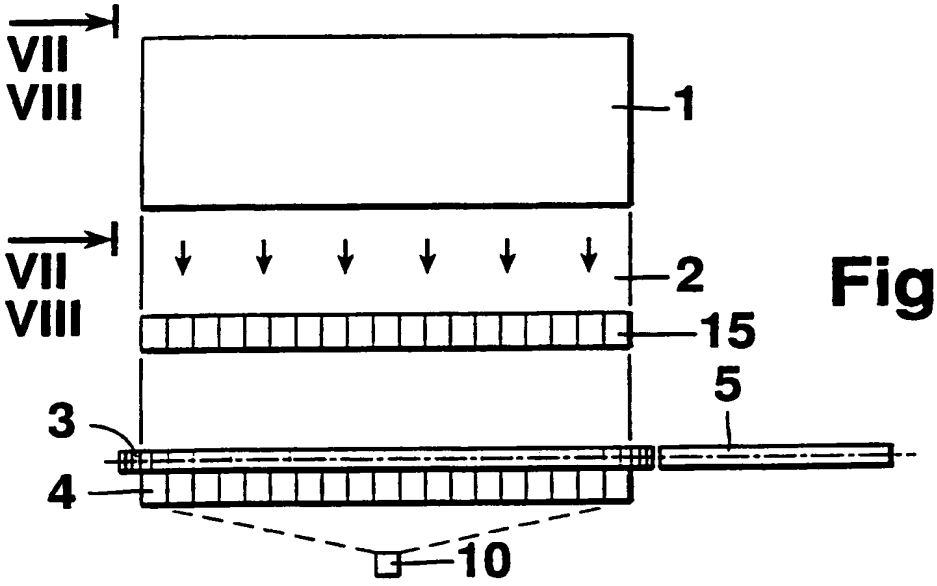

Fig. 6

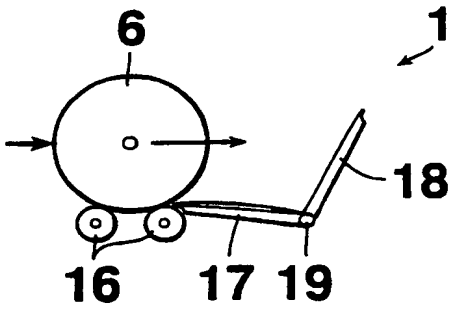

Fig. 7

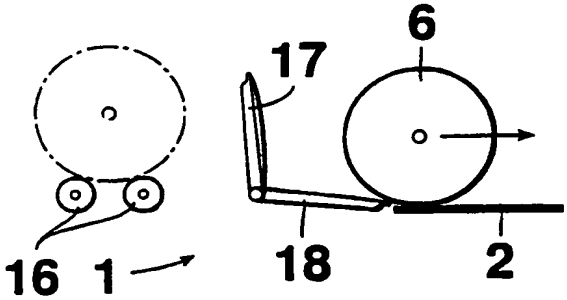

Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 98/00966

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B26F 3/00, B26D 7/06, B65H 35/02
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPIL, EDOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4550550 A (SCOTT), 5 November 1985 (05.11.85), column 1, line 55 - column 2, line 9; column 10, line 27 - line 43, figures 3,4, abstract --	1-10
A	US 4270683 A (CROSBY), 2 June 1981 (02.06.81), abstract --	1-10
A	US 3904097 A (GRAMBO, JR. ET AL.), 9 Sept 1975 (09.09.75), abstract --	1-10
A	US 2742965 A (FRED H. DRUMMOND JR., INDIANAPOLIS, IND., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INC., NEW YORK), 24 April 1956 (24.04.56) --	1-10

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
26 March 1999	30 -03- 1999
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 98/00966

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